

State of California  
The Resources Agency  
DEPARTMENT OF FISH AND GAME

JUVENILE SPRING-RUN CHINOOK SALMON EMERGENCE, REARING AND  
OUTMIGRATION PATTERNS IN DEER AND MILL CREEKS, TEHAMA COUNTY,  
FOR THE 1996 BROOD YEAR

SPORT FISH RESTORATION ANNUAL PROGRESS REPORT

by



Colleen D. Harvey  
Associate Fishery Biologist  
Inland Fisheries Division

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## INTRODUCTION

This annual brood year report documents the length frequency of spring-run chinook salmon (*Oncorhynchus tshawytscha*) smolts emigrating from Mill and Deer creeks and the timing of spring-run yearling outmigration. Juvenile growth patterns are followed from emergence through rearing and outmigration. This 1996 brood year (BY) report will cover the 1996 adult spring-run chinook salmon (spring run) population counts, onset and peak of spawning, calculated, timing of 96 BY fry emergence, sampling efforts for spring-run juvenile growth rates and spring-run salmon yearling outmigration.

Record high flows in Mill and Deer Creeks in January 1997 appear to have destroyed a large portion of 1996 BY incubating eggs and pre-emergent fry and displaced any remaining emergent fry downstream. Almost no juvenile spring run were observed in the tributary rearing habitat through the spring and summer of 1997 and monitoring gear detected only one yearling spring run emigrating from these tributaries in the fall of 1997 when storms produced increased flows and turbidity that normally trigger downstream movement of yearlings.

This 96 BY report is the forth Juvenile Spring-Run Chinook Salmon Emergence, Rearing and Outmigrant Report for Mill and Deer Creeks. This research is funded through the Federal Sport Fish Restoration Act for the purpose of investigating spring-run life-history in Mill and Deer creeks.

### 1996 Adult Population Counts and Spawning Surveys in Mill and Deer Creeks.

An estimated 253 adult spring run entered Mill Creek in 1996. This estimate was derived from electronic and visual counts at Clough Dam, April through June 1996. Spring-run chinook salmon spawning surveys for these salmon extended from September through early November (Table 1). The purpose of these spawning surveys is to determine the onset, peak and termination of spawning for and to collect tissue samples from carcasses for genetic analysis. Spring-run chinook spawning habitat in Mill Creek extends from approximately the Lassen National Park boundary downstream to the Little Mill Creek confluence (Figure 1). Spawning surveys in 1996 extended from the Hwy-36 Bridge downstream to 2 miles below Black Rock. The first redds were observed on 25 September. Given the limited number of surveys made, the peak of spawning appeared to be the week of 15 October. October 31 was the last date live salmon were observed on redds.

In Deer Creek, an estimated 614 spring-run chinook salmon spawned in 1996. This estimate was derived from a snorkel survey of the adult holding habitat from Upper Deer Creek Falls downstream to Iron Mountain Creek. Spawning surveys extended from Upper Falls downstream to Murphy Trail (Table 2 and Figure 2). The first redds were observed 11 September. On 23 October live adult salmon were still observed on redds. The first week in October appeared to be the peak of spawning activity.

TABLE 1. 1996 Adult Spring-Run Salmon Spawner Counts in Mill Creek.

Redd counts are cumulative for the season - all redds are counted in every survey.

| <u>Date</u> | <u>Source</u> | <u>Location</u>                                 | <u>Total<br/>Redds</u> | <u>♂</u> | <u>♀</u> | <u>Jacks</u> | <u>?</u> | <u>Live</u> |
|-------------|---------------|---|------------------------|----------|----------|--------------|----------|-------------|
| 09/06/96    | DFG           | Black Rock Falls to Bridge Area                 | 0                      | 0        | 0        |              |          | 0           |
| 09/16/96    | LNF           | Savercool Place to Black Rock                   | 0                      | 0        | 0        |              |          | 0           |
| 09/16/96    | LNF           | Hwy-36 Bridge to Little Hole-in-the-Ground      | 0                      | 0        | 0        |              |          | 0           |
| 09/24/96    | DFG           | Hwy-36 Bridge to Little Hole-in-the-Ground      | 0                      | 0        | 0        |              |          | 0           |
| 09/25/96    | DFG           | Savercool Place to Black Rock                   | 1                      | 0        | 0        |              |          | 0           |
| 10/01/96    | LNF           | Hwy-36 Bridge to Little Hole-in-the-Ground      | 3                      | 0        | 0        |              |          | 2           |
| 10/01/96    | LNF           | Savercool Place to Black Rock                   | 3                      | 2        | 0        |              |          | 2           |
| 10/08/96    | LNF           | Hwy-36 Bridge to Little Hole-in-the-Ground      | 3                      | 0        | 0        |              |          | 2           |
| 10/08/96    | LNF           | Savercool Place to Black Rock                   | 2                      | 0        | 0        |              |          | 1           |
| 10/15/96    | LNF           | Hwy-36 Bridge to Little Hole-in-the-Ground      | 5                      | 0        | 1        |              |          | 2           |
| 10/15/96    | LNF           | Savercool Place to Black Rock                   | 7                      | 2        | 0        |              |          | 1           |
| 10/17/96    | LNF           | Little Hole-in-the-Ground to Hole-in-the-Ground | 20                     | 0        | 1        |              |          | 0           |
| 10/17/96    | LNF           | Hole-in-the-Ground to Rock Gulch Creek          | 21                     | 0        | 0        |              |          | 2           |
| 10/22/96    | LNF           | Hwy-36 to Little Hole-in-the-Ground             | 12                     | 1        | 2        |              |          | 1           |
| 10/22/96    | LNF           | Savercool Place to Black Rock                   | 7                      | 0        | 0        |              |          | 0           |
| 10/30/96    | LNF           | Hwy-36 to Cable Crossing                        | 4                      | 0        | 0        |              |          | 0           |
| 10/31/93    | LNF           | Cable Crossing to Little-Hole-in-the-Ground     | 2                      | 0        | 0        |              |          | 0           |
| 10/31/96    | LNF           | Rocky Gulch to Big Bend                         | 36                     | 0        | 2        |              |          | 1           |
| 11/05/96    | LNF           | Black Rock to below Ranch House                 | 3                      | 0        | 0        | 1            |          | 0           |

# Mill Creek Spring-Run Chinook Monitoring Locations

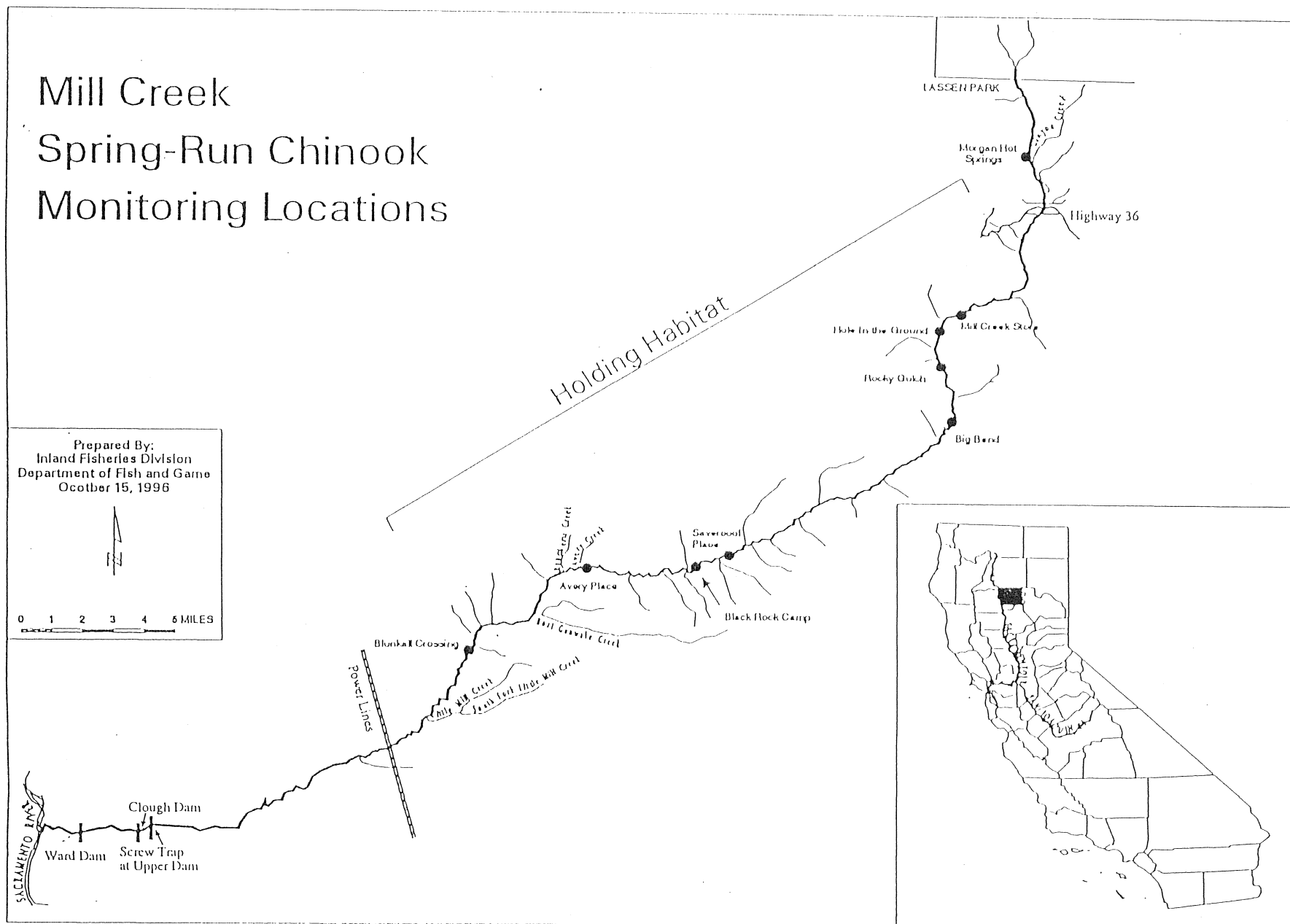


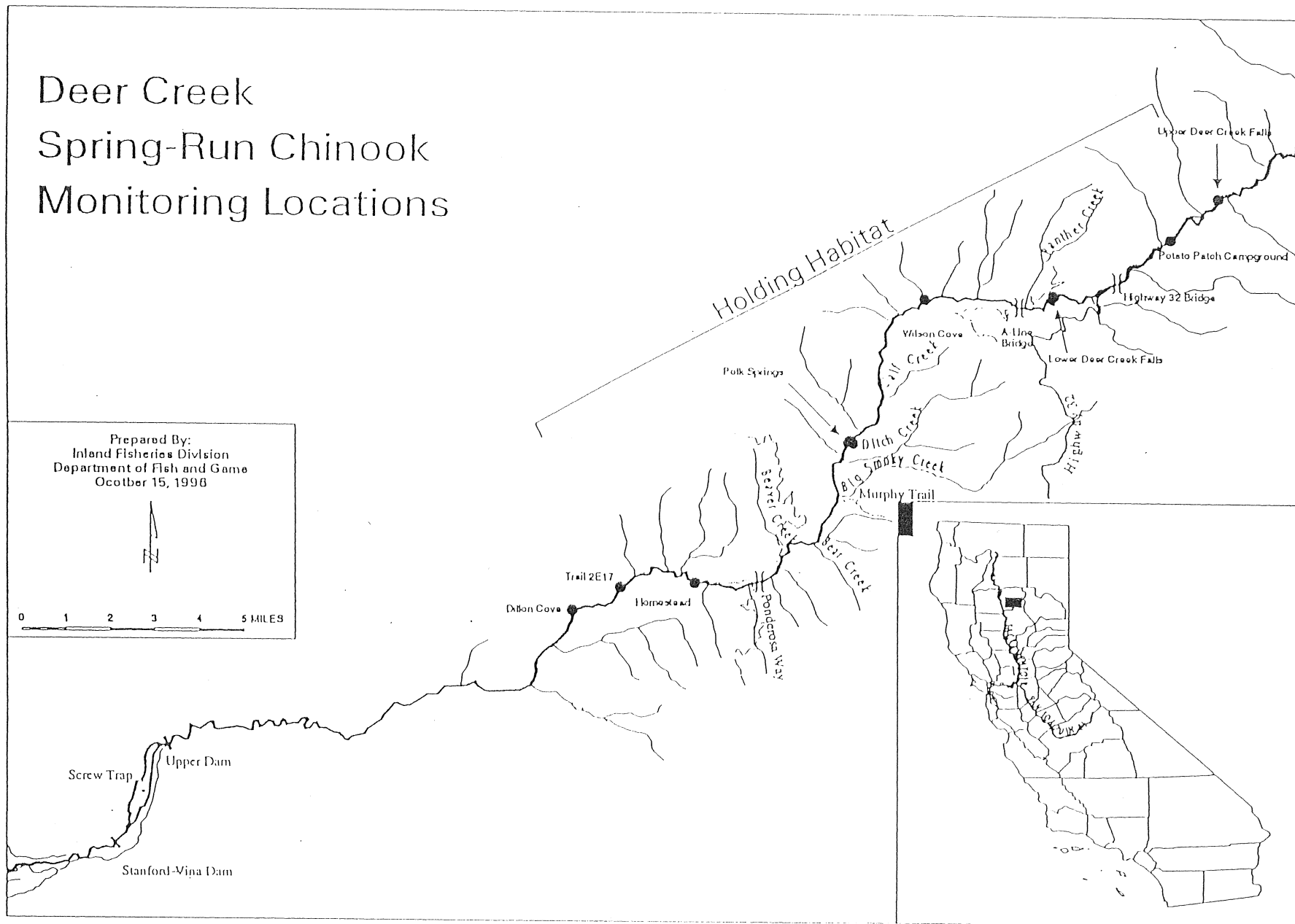
TABLE 2. 1996 Adult Spring-Run Salmon Spawner Counts in Deer Creek.

Redd counts are cumulative for the season - all redds are counted in every survey.

| <u>Date</u> | <u>Source</u> | <u>Location</u>                                     | <u>Total<br/>Redds</u> | <u>♂</u> | <u>♀</u> | <u>Jacks</u> | <u>?</u> | <u>Live</u> |
|-------------|---------------|---|------------------------|----------|----------|--------------|----------|-------------|
| 09/06/96    | DFG           | Upper Falls Trail Head                              | 0                      | 0        | 0        |              |          | 0           |
| 09/11/96    | DFG           | Upper Falls to Potato Patch Campground              | 2                      | 0        | 0        |              |          | 0           |
| 09/13/96    | DFG           | Lower Falls to A-line Bridge                        | 3                      | 0        | 0        |              |          | 1           |
| 09/18/96    | DFG           | Upper Falls to Potato Patch Campground              | 29                     | 0        | 0        |              |          | 20          |
| 09/19/96    | DFG           | Lower Fall to A-line Bridge                         | 33                     | 0        | 0        |              |          | 6           |
| 09/26/96    | DFG           | A-line to Lower Falls                               | 47                     | 1        | 1        |              | 3        | 20          |
| 09/26/96    | LNF           | Upper Falls to Potato Patch Campground              | 101                    | 0        | 6        |              |          | 50          |
| 09/26/96    | LNF           | Lower Falls to A-line Bridge                        | 47                     | 0        |          |              | 5        | 22          |
| 10/02/96    | LNF           | Upper Falls to Potato Patch Campground              | 133                    | 2        | 12       |              |          | 49          |
| 10/03/96    | LNF           | Lower Falls to A-line Bridge                        | 55                     | 3        | 6        |              |          | 40          |
| 10/08/96    | LNF           | Upper Falls to Potato Patch Campground              | 122                    | 7        | 12       |              |          | 18          |
| 10/10/96    | DFG           | Lower Falls to A-line Bridge                        | 65                     | 4        | 13       |              |          | 11          |
| 10/10/96    | LNF           | Potato Patch Campground downstream to Hwy-23 Bridge | 24                     | 2        | 0        | 1            | 5        | 1           |
| 10/16/96    | LNF           | A-line to Dead Horse Creek                          | 57                     | 2        | 2        |              |          | 0           |
| 10/16/96    | LNF           | Lower Falls to A-line Bridge                        | 68                     | 0        | 4        |              | 4        | 3           |
| 10/23/96    | LNF           | Red Bridge to Lower Falls                           | 29                     | 3        | 3        |              |          | 0           |
| 10/23/93    | LNF           | Dead Horse Creek to Wilson Cove                     | 38                     | 0        | 0        |              |          | 0           |
| 10/23/96    | LNF           | Polk Springs to Murphy Trail                        | 25                     | 2        | 3        |              | 1        | 1           |

FIGURE 2.

# Deer Creek Spring-Run Chinook Monitoring Locations



### Egg Incubation, Hatching and Fry Emergence

To calculate estimated time of fry emergence, daily temperature units (DTU) were calculated from the water temperature records on each creek. A DTU is defined as the average daily water temperature (in °F) minus 32. From the time of egg fertilization, a cumulative total of 1550 DTU's is required for the egg to hatch and the fry to emerge.

In Mill Creek a temperature recorder located upstream of Highway-36 Bridge was recovered after the 1 January flood event. Although, since the recorder was displaced during the flood, the data after 1 January is not useable. Using these temperatures as a surrogate for water temperatures in spring-run spawning habitat (no spring run were observed spawning upstream of highway-36 in 1996), the estimated time of egg hatching and fry emergence can be calculated from daily water temperature records (Table 3). Only 911 DTU's's had accumulated by the time of the flood on 1 January 1997. Hatched spring-run alevins had not emerged from the gravels and were either washed downstream or buried by gravels during the flood event.

In Deer Creek, the water temperature recorder at A-line Bridge survived the January flood event. All other temperature recorders in Deer Creek were lost in the flood. Using daily water temperature records at A-line Bridge, estimated time of fry emergence was 27 February 1997 (Table 4). By the time of the January flood event only 1062 DTU's had accumulated from the peak of spawning. Hatched spring-run alevins had not emerged from the gravels and were either washed downstream or buried by gravels during the flood event.

### Juvenile Salmon Rearing Studies

In Mill Creek, electrofishing surveys to sample spring-run fry began in January 1997 and extended through the following December. Nineteen surveys were made in the Black Rock area and no spring-run juveniles were encountered (Table 5). This suggests that either the 96 year class was destroyed in the 97 flood event or all alevins were prematurely washed out of Mill Creek. In Deer Creek, electrofishing surveys were conducted during the same time periods as Mill Creek. Thirty surveys in the A-line and Ponderosa Way areas found no 96 BY spring-run juveniles (Table 6).

### Fry and Yearling Emigration

Rotary screw traps were placed in Mill and Deer creeks to sample outmigrant yearling spring-run salmon and record size range of yearlings and timing of emigration. The rotary screw trap in Mill Creek was fished 53 days from October 1997 through January 1998 (Table 7). One yearling spring-run salmon was trapped in November. The rotary screw trap in Deer Creek was fished during this same time period for a total of 57 days. No yearling spring-run chinook salmon were captured (Table 8).

### Status of Spring-Run Chinook Salmon and Management Actions

On 13 June 1997, the California Fish and Game Commission designated the Sacramento River spring-run chinook salmon as a candidate species under the California Endangered Species Act.

Table 3. Mean daily water temperatures in Mill Creek upstream from Highway 36 bridge crossing. Estimated time of egg hatching and fry emergence is based on October 15 peak of spawning, and calculated from daily temperature units (DTU). A DTU is the mean daily temperature in Fahrenheit minus 32. A flood on January 1 displaced the temperature recorder from the creek channel.

| DAY | OCT 96 |      |         | NOV 96 |      |         | DEC 96 |      |         |
|-----|--------|------|---------|--------|------|---------|--------|------|---------|
|     | mean   | DTU  | cum DTU | mean   | DTU  | cum DTU | mean   | DTU  | cum DTU |
| 1   | 54.7   |      |         | 45.6   | 13.6 | 267.8   | 41.6   | 9.6  | 654.8   |
| 2   | 54.9   |      |         | 46.3   | 14.3 | 282.1   | 40.5   | 8.5  | 663.3   |
| 3   | 54.5   |      |         | 46.2   | 14.2 | 296.3   | 42.2   | 10.2 | 673.5   |
| 4   | 54.3   |      |         | 46.1   | 14.1 | 310.4   | 42.2   | 10.2 | 683.7   |
| 5   | 54.4   |      |         | 43.8   | 11.8 | 322.2   | 39.4   | 7.4  | 691.1   |
| 6   | 55.0   |      |         | 44.0   | 12.0 | 334.2   | 41.1   | 9.1  | 700.2   |
| 7   | 55.2   |      |         | 45.7   | 13.7 | 347.9   | 40.4   | 8.4  | 708.6   |
| 8   | 55.1   |      |         | 46.5   | 14.5 | 362.4   | 41.8   | 9.8  | 718.4   |
| 9   | 55.1   |      |         | 46.9   | 14.9 | 377.3   | 40.8   | 8.8  | 727.2   |
| 10  | 53.9   |      |         | 47.6   | 15.6 | 392.9   | 39.1   | 7.1  | 734.3   |
| 11  | 52.6   |      |         | 47.9   | 15.9 | 408.8   | 41.2   | 9.2  | 743.5   |
| 12  | 53.0   |      |         | 48.3   | 16.3 | 425.1   | 41.5   | 9.5  | 753.0   |
| 13  | 52.1   |      |         | 48.5   | 16.5 | 441.6   | 41.1   | 9.1  | 762.1   |
| 14  | 50.1   | 18.1 | 18.1    | 45.5   | 13.5 | 455.1   | 40.0   | 8.0  | 770.1   |
| 15  | 49.7   | 17.7 | 35.8    | 43.6   | 11.6 | 466.7   | 41.3   | 9.3  | 779.4   |
| 16  | 47.3   | 15.3 | 51.1    | 43.1   | 11.1 | 477.8   | 42.7   | 10.7 | 790.1   |
| 17  | 48.0   | 16.0 | 67.1    | 42.2   | 10.2 | 488.0   | 41.5   | 9.5  | 799.6   |
| 18  | 46.7   | 14.7 | 81.8    | 44.0   | 12.0 | 500.0   | 41.0   | 9.0  | 808.6   |
| 19  | 45.7   | 13.7 | 95.5    | 44.0   | 12.0 | 512.0   | 41.7   | 9.7  | 818.3   |
| 20  | 44.8   | 12.8 | 108.3   | 46.1   | 14.1 | 526.1   | 40.0   | 8.0  | 826.3   |
| 21  | 45.3   | 13.3 | 121.6   | 46.9   | 14.9 | 541.0   | 38.6   | 6.6  | 832.9   |
| 22  | 47.1   | 15.1 | 136.7   | 43.7   | 11.7 | 552.7   | 37.6   | 5.6  | 838.5   |
| 23  | 48.2   | 16.2 | 152.9   | 44.1   | 12.1 | 564.8   | 40.2   | 8.2  | 846.7   |
| 24  | 48.0   | 16.0 | 168.9   | 45.2   | 13.2 | 578.0   | 40.5   | 8.5  | 855.2   |
| 25  | 42.0   | 10.0 | 178.9   | 44.2   | 12.2 | 590.2   | 42.1   | 10.1 | 865.3   |
| 26  | 42.9   | 10.9 | 189.8   | 43.2   | 11.2 | 601.4   | 39.4   | 7.4  | 872.7   |
| 27  | 45.4   | 13.4 | 203.2   | 43.6   | 11.6 | 613.0   | 39.8   | 7.8  | 880.5   |
| 28  | 45.9   | 13.9 | 217.1   | 43.5   | 11.5 | 624.5   | 41.2   | 9.2  | 889.7   |
| 29  | 41.4   | 9.4  | 226.5   | 41.4   | 9.4  | 633.9   | 40.3   | 8.3  | 898.0   |
| 30  | 45.7   | 13.7 | 240.2   | 43.3   | 11.3 | 645.2   | 38.9   | 6.9  | 904.9   |
| 31  | 46.0   | 14.0 | 254.2   |        |      |         | 37.7   | 5.7  | 910.6   |



Table 4 Mean daily water temperatures in Deer Creek near A-Line Bridge crossing. Estimated time of egg hatching and fry emergence is based on October 2 peak of spawning, and calculated from daily temperature units (DTU). A DTU equals the mean daily temperature in Fahrenheit minus 32.

| DAY | OCT 96 |      |        | NOV 96 |      |        | DEC 96 |      |        | JAN 97 |      |        | FEB 97 |      |        |
|-----|--------|------|--------|--------|------|--------|--------|------|--------|--------|------|--------|--------|------|--------|
|     | mean   | DTU  | cumDTU | mean   | DTU  | cumDTU | mean   | DTU  | cumDTU | mean   | DTU  | cumDTU | mean   | DTU  | cumDTU |
| 1   | 52.8   | 20.8 |        | 44.4   | 12.4 | 458.3  | 39.0   | 7.0  | 796.3  | 43.8   | 11.8 | 1074.1 | 40.1   | 8.1  | 1304.3 |
| 2   | 52.4   | 20.4 | 20.4   | 44.0   | 12.0 | 470.3  | 39.8   | 7.8  | 804.1  | 42.2   | 10.2 | 1084.3 | 40.2   | 8.2  | 1312.5 |
| 3   | 52.1   | 20.1 | 40.5   | 44.0   | 12.0 | 482.3  | 40.7   | 8.7  | 812.8  | 41.2   | 9.2  | 1093.5 | 40.9   | 8.9  | 1321.4 |
| 4   | 52.1   | 20.1 | 60.6   | 42.3   | 10.3 | 492.6  | 42.6   | 10.6 | 823.4  | 40.5   | 8.5  | 1102.0 | 39.8   | 7.8  | 1329.2 |
| 5   | 52.1   | 20.1 | 80.7   | 41.1   | 9.1  | 501.7  | 41.2   | 9.2  | 832.6  | 38.5   | 6.5  | 1108.5 | 39.1   | 7.1  | 1336.3 |
| 6   | 52.4   | 20.4 | 101.1  | 41.7   | 9.7  | 511.4  | 41.2   | 9.2  | 841.8  | 39.2   | 7.2  | 1115.7 | 39.9   | 7.9  | 1344.2 |
| 7   | 52.2   | 20.2 | 121.3  | 42.7   | 10.7 | 522.1  | 43.2   | 11.2 | 853.0  | 39.5   | 7.5  | 1123.2 | 39.4   | 7.4  | 1351.6 |
| 8   | 52.2   | 20.2 | 141.5  | 43.4   | 11.4 | 533.5  | 44.0   | 12.0 | 865.0  | 40.4   | 8.4  | 1131.6 | 40.2   | 8.2  | 1359.8 |
| 9   | 51.9   | 19.9 | 161.4  | 44.0   | 12.0 | 545.5  | 43.0   | 11.0 | 876.0  | 40.4   | 8.4  | 1140.0 | 40.8   | 8.8  | 1368.6 |
| 10  | 49.9   | 17.9 | 179.3  | 44.6   | 12.6 | 558.1  | 42.9   | 10.9 | 886.9  | 40.1   | 8.1  | 1148.1 | 40.7   | 8.7  | 1377.3 |
| 11  | 50.5   | 18.5 | 197.8  | 44.6   | 12.6 | 570.7  | 43.7   | 11.7 | 898.6  | 39.3   | 7.3  | 1155.4 | 40.7   | 8.7  | 1386.0 |
| 12  | 50.3   | 18.3 | 216.1  | 46.0   | 14.0 | 584.7  | 43.4   | 11.4 | 910.0  | 34.0   | 2.0  | 1157.4 | 40.7   | 8.7  | 1394.7 |
| 13  | 48.0   | 16.0 | 232.1  | 44.0   | 12.0 | 596.7  | 40.6   | 8.6  | 918.6  | 34.5   | 2.5  | 1159.9 | 40.7   | 8.7  | 1403.4 |
| 14  | 47.1   | 15.1 | 247.2  | 42.1   | 10.1 | 606.8  | 40.2   | 8.2  | 926.8  | 37.1   | 5.1  | 1165.0 | 40.7   | 8.7  | 1412.1 |
| 15  | 45.3   | 13.3 | 260.5  | 41.3   | 9.3  | 616.1  | 40.6   | 8.6  | 935.4  | 39.1   | 7.1  | 1172.1 | 40.7   | 8.7  | 1420.8 |
| 16  | 44.6   | 12.6 | 273.1  | 41.5   | 9.5  | 625.6  | 40.9   | 8.9  | 944.3  | 40.9   | 8.9  | 1181.0 | 40.7   | 8.7  | 1429.5 |
| 17  | 45.5   | 13.5 | 286.6  | 45.4   | 13.4 | 639.0  | 39.1   | 7.1  | 951.4  | 40.7   | 8.7  | 1189.7 | 40.7   | 8.7  | 1438.2 |
| 18  | 44.1   | 12.1 | 298.7  | 46.8   | 14.8 | 653.8  | 38.9   | 6.9  | 958.3  | 40.5   | 8.5  | 1198.2 | 40.7   | 8.7  | 1446.9 |
| 19  | 42.3   | 10.3 | 309.0  | 47.0   | 15.0 | 668.8  | 39.2   | 7.2  | 965.5  | 39.3   | 7.3  | 1205.5 | 40.7   | 8.7  | 1455.6 |
| 20  | 42.1   | 10.1 | 319.1  | 47.3   | 15.3 | 684.1  | 37.2   | 5.2  | 970.7  | 38.4   | 6.4  | 1211.9 | 40.7   | 8.7  | 1464.3 |
| 21  | 43.1   | 11.1 | 330.2  | 46.4   | 14.4 | 698.5  | 37.6   | 5.6  | 976.3  | 35.7   | 3.7  | 1215.6 | 40.62  | 8.6  | 1472.9 |
| 22  | 44.8   | 12.8 | 343.0  | 42.9   | 10.9 | 709.4  | 38.7   | 6.7  | 983.0  | 36.8   | 4.8  | 1220.4 | 40.68  | 8.7  | 1481.6 |
| 23  | 46.4   | 14.4 | 357.4  | 44.5   | 12.5 | 721.9  | 38.9   | 6.9  | 989.9  | 38.5   | 6.5  | 1226.9 | 39.68  | 7.7  | 1489.3 |
| 24  | 43.6   | 11.6 | 369.0  | 44.4   | 12.4 | 734.3  | 38.9   | 6.9  | 996.8  | 38.7   | 6.7  | 1233.6 | 39.23  | 7.2  | 1496.5 |
| 25  | 41.2   | 9.2  | 378.2  | 42.6   | 10.6 | 744.9  | 40.2   | 8.2  | 1005.0 | 40.0   | 8.0  | 1241.6 | 40.68  | 8.7  | 1505.2 |
| 26  | 42.3   | 10.3 | 388.5  | 41.2   | 9.2  | 754.1  | 39.7   | 7.7  | 1012.7 | 40.6   | 8.6  | 1250.2 | 42.22  | 10.2 | 1515.4 |
| 27  | 43.2   | 11.2 | 399.7  | 41.6   | 9.6  | 763.7  | 41.0   | 9.0  | 1021.7 | 41.0   | 9.0  | 1259.2 | 41.31  | 9.3  | 1524.7 |
| 28  | 43.8   | 11.8 | 411.5  | 39.7   | 7.7  | 771.4  | 41.2   | 9.2  | 1030.9 | 40.8   | 8.8  | 1268.0 | 39.64  | 7.6  | 1532.4 |
| 29  | 43.4   | 11.4 | 422.9  | 39.8   | 7.8  | 779.2  | 41.3   | 9.3  | 1040.2 | 41.1   | 9.1  | 1277.1 |        |      |        |
| 30  | 43.7   | 11.7 | 434.6  | 42.1   | 10.1 | 789.3  | 42.3   | 10.3 | 1050.5 | 41.2   | 9.2  | 1286.3 |        |      |        |
| 31  | 43.3   | 11.3 | 445.9  |        |      |        | 43.8   | 11.8 | 1062.3 | 41.9   | 9.9  | 1296.2 |        |      |        |

Feb 10-20 est.

TABLE 5. Electrofishing Surveys in Mill Creek and Catch Records to Determine if any 96 BY Juveniles were Rearing in Mill Creek.

| Date     | Location   | Yearling<br>CHN | Fry<br>CHN | RBT | SCP | LP | RH | BT | SKR |
|----------|------------|-----------------|------------|-----|-----|----|----|----|-----|
| 12/96    | no surveys |                 |            |     |     |    |    |    |     |
| 01/30/97 | Black Rock | 0               | 0          | 2   | 4   |    |    |    |     |
| 02/04/97 | Black Rock | 0               | 0          | 2   | 2   |    |    |    |     |
| 02/10/97 | Black Rock | 0               | 0          | 5   | 3   |    |    | 1  |     |
| 02/24/97 | Black Rock | 0               | 0          | 17  | 6   |    |    |    |     |
| 03/03/97 | Black Rock | 0               | 0          | 6   | 2   |    |    |    |     |
| 03/12/97 | Black Rock | 0               | 0          | 16  | 8   |    |    |    |     |
| 03/17/97 | Black Rock | 0               | 0          | 3   | 5   |    |    |    |     |
| 03/24/97 | Black Rock | 0               | 0          | 13  | 4   |    |    |    |     |
| 03/31/97 | Black Rock | 0               | 0          | 6   |     |    |    |    | 1   |
| 04/07/97 | Black Rock | 0               | 0          | 6   | 1   |    |    |    |     |
| 04/15/97 | Black Rock | 0               | 0          | 17  | 5   |    |    |    |     |
| 05/13/97 | Black Rock | 0               | 0          | 5   | 1   |    |    |    | 1   |
| 05/27/97 | Black Rock | 0               | 0          | 34  | 3   |    |    |    | 1   |
| 06/10/97 | Black Rock | 0               | 0          | 39  | 4   |    |    |    |     |
| 06/24/97 | Black Rock | 0               | 0          | 21  |     |    |    |    |     |
| 06/25/97 | Black Rock | 0               | 0          | 13  | 1   |    |    | 4  |     |
| 07/16/97 | Black Rock | 0               | 0          | 14  | 7   |    |    |    | 3   |
| 12/08/97 | Black Rock | 0               | 0          | 9   | 2   |    |    |    |     |
| 12/16/97 | Black Rock | 0               | 0          | 11  | 12  |    |    |    | 18  |

TABLE 6. Electrofishing Surveys in Deer Creek and Catch Records to Determine if any 96 BY Juveniles were Rearing in Deer Creek

| Date     | Location   | Yearling<br>CHN | Fry<br>CHN | RBT | SCP | LP | RH | SKR |
|----------|------------|-----------------|------------|-----|-----|----|----|-----|
| 12/96    | no surveys |                 |            |     |     |    |    |     |
| 01/31/97 | Ponderosa  | 0               | 0          | 1   |     |    |    |     |
| 02/03/97 | A-line     | 0               | 0          |     | 2   |    |    |     |
| 02/06/97 | Ponderosa  | 0               | 0          | 11  | 2   |    |    |     |
| 02/11/97 | A-line     | 0               | 0          | 3   |     |    |    |     |
| 02/25/97 | Ponderosa  | 0               | 0          |     | 1   |    |    |     |
| 02/26/97 | A-line     | 0               | 0          | 16  |     |    |    |     |
| 02/27/97 | A-line     | 0               | 0          |     |     |    |    |     |
| 03/04/97 | A-line     | 0               | 0          | 16  | 1   |    |    |     |
| 03/06/97 | Ponderosa  | 0               | 0          | 3   | 1   |    | 1  |     |
| 03/13/97 | A-line     | 0               | 0          | 4   |     |    |    |     |
| 03/18/97 | Ponderosa  | 0               | 0          | 1   |     |    | 1  |     |
| 03/19/97 | A-line     | 0               | 0          | 4   |     |    |    |     |
| 03/25/97 | Ponderosa  | 0               | 0          | 12  |     |    | 1  |     |
| 03/26/97 | A-line     | 0               | 0          | 11  |     |    |    |     |
| 04/01/97 | Ponderosa  | 0               | 0          | 1   |     | 5  | 1  |     |
| 04/02/97 | A-line     | 0               | 0          | 1   |     |    |    |     |
| 04/08/97 | A-line     | 0               | 0          | 1   |     |    |    |     |
| 04/16/97 | Ponderosa  | 0               | 0          | 3   | 1   |    | 1  |     |
| 05/12/97 | A-line     | 0               | 0          | 16  |     |    |    |     |
| 06/04/97 | A-line     | 0               | 0          | 49  |     |    |    |     |
| 06/16/97 | Ponderosa  | 0               | 0          | 49  | 1   |    | 1  |     |
| 06/18/97 | A-line     | 0               | 0          | 50  |     |    |    |     |
| 07/09/97 | A-line     | 0               | 0          | 65  | 1   |    |    |     |
| 09/16/97 | A-line     | 0               | 0          | 17  |     |    |    |     |
| 12/04/97 | A-line     | 0               | 0          | 25  | 4   |    |    |     |
| 12/09/97 | Ponderosa  | 0               | 0          | 12  | 1   |    | 1  | 1   |
| 12/15/97 | A-line     | 0               | 0          | 9   |     |    |    |     |
| 12/17/97 | Ponderosa  | 0               | 0          | 23  | 2   |    | 2  |     |
| 12/22/97 | A-line     | 0               | 0          | 11  |     |    |    |     |
| 12/30/97 | A-line     | 0               | 1 a/       | 16  |     | 1  |    |     |

a/ 97 BY fry.

TABLE 7. Rotary Screw Trap Real-time Monitoring in Mill Creek to Determine Timing of 96 BY Spring-Run Yearling Outmigration.

| Date     | Status                                   | Flow<br>cfs | Turbidity<br>cm | Yearling<br>CHN | Fry<br>CHN | RBT | SQ | HH | SCP | LP | RH | SKR |
|----------|--|-------------|-----------------|-----------------|------------|-----|----|----|-----|----|----|-----|
| 09/30/97 | installed                                |             |                 |                 |            |     |    |    |     |    |    |     |
| 10/02/97 | check                                    | <130        | >112            | 0               | 0          |     |    |    |     |    |    |     |
| 10/07/97 | check                                    | <130        | >112            | 0               | 0          |     |    |    |     |    |    |     |
| 10/09/97 | check                                    | <130        | 38              | 0               | 0          | 5   | 82 |    |     |    |    |     |
| 10/10/97 | check                                    | <130        | 36 cm           | 0               | 0          | 20  | 84 |    |     | 2  |    | 6   |
| 10/16/97 | check                                    | <130        | >112            | 0               | 0          |     |    | 7  | 5   |    |    |     |
| 10/20/97 | check                                    | <130        | >112            | 0               | 0          |     |    |    |     |    |    |     |
| 10/24/97 | pull                                     | <130        | >112            | 0               | 0          | 1   |    |    |     |    |    |     |
| 10/27/97 | set                                      |             |                 |                 |            |     |    |    |     |    |    |     |
| 10/31/97 | pull                                     | <130        | >112            |                 |            | 2   |    |    |     |    |    | 1   |
| 11/03/97 | set                                      |             |                 |                 |            |     |    |    |     |    |    |     |
| 11/06/97 | check                                    | 134         | >112            | 0               | 0          |     |    |    | 2   |    |    | 1   |
| 11/07/97 | pull                                     | 141         | >112            | 0               | 0          | 1   |    |    |     |    |    |     |
| 11/10/97 | set                                      |             |                 |                 |            |     |    |    |     |    |    |     |
| 11/11/97 | check                                    | 143         | >116            | 0               | 0          |     |    |    |     |    |    |     |
| 11/12/97 | check                                    | 139         | >116            | 0               | 0          |     |    |    |     |    |    |     |
| 11/13/97 | check                                    | 139         | >116            | 0               | 0          | 1   |    | 1  |     |    |    |     |
| 11/14/97 | check                                    | 163         | >116            | 0               | 0          |     |    |    |     |    |    |     |
| 11/16/97 | check                                    | 195         | 79              | 0               | 0          | 1   |    | 2  |     |    |    |     |
| 11/17/97 | check                                    | 253         | 43              | 0               | 0          | 3   |    | 23 |     |    | 1  |     |
| 11/18/97 | check                                    | 189         | 97              | 0               | 0          | 1   |    | 11 | 1   |    |    |     |
| 11/19/97 | check                                    | 217         | 100             | 0               | 0          |     |    | 14 | 1   | 2  | 1  |     |
| 11/20/97 | check                                    | 212         | 72              | 0               | 0          |     |    | 26 | 1   |    |    |     |
| 11/21/97 | check                                    | 167         | >116            | 0               | 0          | 1   |    | 21 |     |    |    | 1   |
| 11/22/97 | check                                    | 157         | >116            | 0               | 0          |     | 5  | 1  |     |    |    |     |
| 11/23/97 | check                                    | 161         | >113            | 0               | 0          |     | 5  |    |     |    | 2  |     |
| 11/24/97 | check                                    | 182         | >118            | 0               | 0          |     |    | 5  |     | 1  |    |     |
| 11/25/97 | check                                    | 410         | 22              | 0               | 0          |     |    | 23 | 3   | 6  |    | 3   |
| 11/26/97 | check                                    | 359         | 42              | 0               | 0          | 1   | 2  | 4  |     | 1  |    |     |
| 11/27/97 | check                                    | 336         | 79              | 1               | 0          | 1   |    |    |     | 2  |    | 4   |
| 11/28/97 | check                                    | 226         | >115            | 0               | 0          |     | 1  | 67 | 7   |    |    | 5   |
| 11/29/97 | check                                    | 196         | >116            | 0               | 0          | 1   |    | 10 | 5   |    |    | 3   |
| 11/30/97 | check                                    | 1125        | 29              | 0               | 0          |     |    | 80 |     |    |    |     |
| 12/01/97 | check                                    | 283         | >116            | 0               | 0          |     | 3  | 10 |     | 3  |    |     |
| 12/02/97 | check                                    | 219         | >116            | 0               | 0          |     | 4  | 16 |     | 1  |    | 1   |
| 12/03/97 | check                                    | 185         | >116            | 0               | 0          | 2   | 2  | 12 |     |    |    |     |
| 12/04/97 | check                                    | 178         | >116            | 0               | 0          |     | 5  | 9  |     |    |    |     |
| 12/05/97 | pull                                     | 172         | >116            | 0               | 0          |     | 2  | 7  | 2   | 3  |    |     |
| 12/07/97 | flow peaked at 2315 - trap on ditch wall |             |                 |                 |            |     |    |    |     |    |    |     |
| 12/08/97 | set                                      |             |                 |                 |            |     |    |    |     |    |    |     |
| 12/09/97 | check                                    | 325         | 97              | 0               | 0          |     | 8  | 10 |     |    |    | 1   |
| 12/10/97 | check                                    | 255         | >116            | 0               | 0          | 2   | 10 | 23 |     | 1  |    | 2   |
| 12/11/97 | check                                    | 212         | >116            | 0               | 0          |     | 1  | 4  |     |    |    |     |
| 12/12/97 | pull                                     | 194         | >116            | 0               | 0          | 1   | 23 | 29 |     | 1  |    | 1   |
| 12/15/97 | set                                      |             |                 |                 |            |     |    |    |     |    |    |     |
| 12/16/97 | check                                    | 275         | >116            | 0               | 0          |     |    | 4  |     |    |    |     |
| 12/17/97 | check                                    | 263         | >116            | 0               | 0          |     |    | 2  | 1   |    | 1  | 1   |
| 12/18/97 | check                                    | 353         | 100             | 0               | 0          |     |    | 11 | 1   |    |    | 3   |
| 12/19/97 | pull                                     | 270         | >116            | 0               | 0          | 1   |    | 3  | 1   |    |    | 3   |
| 12/22/97 | set                                      |             |                 |                 |            |     |    |    |     |    |    |     |
| 12/23/97 | check                                    | 187         | >116            | 0               | 0          |     |    |    |     |    |    |     |
| 12/24/97 | check                                    | 180         | >116            | 0               | 0          |     |    | 1  |     | 1  |    |     |
| 01/22/98 | set                                      |             |                 |                 |            |     |    |    |     |    |    |     |
| 01/23/98 | check                                    | 442         | >116            | 0               | 0          |     |    |    |     |    |    |     |
| 01/24/98 | check                                    | 410         | >116            | 0               | 3          | 2   |    | 9  | 1   | 2  |    |     |
| 01/25/98 | check                                    | 364         | >116            | 0               | 4          |     |    | 8  |     | 1  |    |     |
| 01/26/98 | check                                    | 955         | 68              | 0               | 8          |     |    | 6  |     | 1  |    |     |
| 01/27/98 | check                                    | 1223        | 73              | 0               | 1          | 1   |    |    |     | 1  |    |     |
| 01/28/98 | check                                    | 709         | 108             | 0               | 6          | 1   | 1  | 6  |     |    |    | 2   |
| 01/29/98 | check                                    | 1647        | 37              | 0               | 9          | 1   |    | 4  |     |    |    |     |
| 01/30/98 | check                                    | 800         | >116            | 0               | 10         |     | 1  | 2  |     |    |    | 1   |
| 01/31/98 | pull                                     | 608         | >116            | 0               | 4          |     |    | 4  |     |    |    | 1   |

TABLE 8. Rotary Screw Trap Real-time Monitoring in Deer Creek to Determine Timing of 96 BY Spring-Run Yearling Outmigration.

| Date     | Status    | Flow<br>cfs | Turbidity<br>cm | Yearling<br>CHN | Fry<br>CHN/RBT | SQ | HH | SCP | LP | RH | SKR |
|----------|-----------|-------------|-----------------|-----------------|----------------|----|----|-----|----|----|-----|
| 09/29/97 | installed | < 130       |                 |                 |                |    |    |     |    |    |     |
| 10/02/97 | check     | BRT         | >116            | 0               | 0              | 0  | 0  | 0   | 0  | 0  |     |
| 10/07/97 | check     | 134         | >116            |                 |                |    |    |     |    |    |     |
| 10/09/97 | check     | 188         | >116            | 0               | 0              | 5  | 1  |     |    |    |     |
| 10/10/97 | check     | 146         | >112            | 0               | 0              | 7  | 2  | 1   |    | 1  |     |
| 10/16/97 | check     | 112         | >112            | 0               | 0              |    |    |     |    |    |     |
| 10/20/97 | check     | 108         | >101            | 0               | 0              |    |    | 1   |    |    |     |
| 10/24/97 | pull      | 108         | >113            | 0               | 0              |    |    |     |    |    |     |
| 10/27/97 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 10/30/97 | check     | 110         | >112            | 0               | 0              | 1  |    | 1   |    |    |     |
| 10/31/97 | pull      | ---         | >112            | 0               | 0              |    |    |     |    |    |     |
| 11/03/97 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 11/06/97 | check     | 106         | >116            | 0               | 0              | 1  | 1  | 1   | 1  |    |     |
| 11/10/97 | check     | 110         | >116            | 0               | 0              |    |    |     |    |    |     |
| 11/11/97 | check     | 120         | >116            | 0               | 0              |    |    |     |    |    |     |
| 11/12/97 | check     | 118         | >116            | 0               | 0              |    | 1  |     |    |    |     |
| 11/13/97 | check     | 118         | >116            | 0               | 0              |    |    |     |    | 1  |     |
| 11/14/97 | check     | 113         | >116            | 0               | 0              |    |    |     |    |    |     |
| 11/14/97 | check     | 202         | >115            | 0               | 0              | 16 | 10 | 1   | 3  | 1  | 4   |
| 11/18/97 | check     | 153         | >113            | 0               | 0              | 5  | 2  | 1   | 2  | 1  | 2   |
| 11/19/97 | check     | 224         | 101             | 0               | 0              | 1  |    | 2   |    | 1  | 1   |
| 11/20/97 | check     | 218         | >116            | 0               | 0              | 31 | 1  | 12  |    | 4  | 2   |
| 11/21/97 | check     | 153         | >116            | 0               | 0              | 4  |    | 1   | 2  | 2  |     |
| 11/22/97 | check     | 138         | >116            | 0               | 0              |    |    |     | 1  | 1  |     |
| 11/23/97 | check     | 142         | 100             | 0               | 0              | 2  | 2  |     | 1  |    |     |
| 11/24/97 | check     | 180         | >117            | 0               | 0              | 3  |    | 3   |    | 1  |     |
| 11/25/97 | check     | 306         | 89              | 0               | 0              | 5  | 2  | 55  | 5  | 2  | 1   |
| 11/26/97 | pull      | 417         | 24              | 0               | 0              |    | 5  | 2   |    |    |     |
| 11/27/97 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 11/28/97 | check     | 223         | >116            | 0               | 0              | 11 |    | 110 | 8  | 3  | 4   |
| 11/29/97 | check     | 186         | >116            | 0               | 0              | 7  |    | 60  | 2  | 1  |     |
| 11/30/97 | pull      | 668         | 72              | 0               | 0              | 1  |    | 100 |    |    |     |
| 12/01/97 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 12/02/97 | check     | 202         | >116            | 0               | 0              | 7  | 2  | 23  | 4  | 7  | 8   |
| 12/03/97 | check     | 173         | >116            | 0               | 0              | 1  |    | 3   | 2  | 4  |     |
| 12/04/97 | check     | 160         | >116            | 0               | 0              | 4  |    | 2   |    | 2  |     |
| 12/05/97 | pull      | 154         | >116            | 0               | 0              | 2  | 1  |     |    | 2  | 1   |
| 12/08/97 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 12/09/97 | check     | 302         | >116            | 0               | 0              | 4  |    | 12  | 2  | 4  | 1   |
| 12/10/97 | check     | 241         | >116            | 0               | 1              | 2  | 3  | 11  |    | 5  | 1   |
| 12/11/97 | check     | 207         | >116            | 0               | 0              | 7  | 1  | 7   |    | 1  | 3   |
| 12/12/97 | pull      | 186         | >116            | 0               | 0              | 2  |    | 2   |    | 2  | 2   |
| 12/15/97 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 12/16/97 | check     | 270         | >116            | 0               | 0              | 1  |    | 1   | 1  | 2  | 1   |
| 12/17/97 | check     | 254         | >116            | 0               | 0              | 4  |    |     | 1  |    | 1   |
| 12/18/97 | check     | 228         | >116            | 0               | 0              | 3  |    | 1   | 1  |    |     |
| 12/19/97 | pull      | 272         | >116            | 0               | 0              | 1  |    | 1   |    | 1  | 1   |
| 12/22/97 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 12/23/97 | check     | 186         | >116            | 0               | 0              | 1  |    |     |    |    |     |
| 12/24/97 | pull      | 175         | >116            | 0               | 0              | 3  |    |     | 1  |    |     |
| 01/05/98 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 01/06/98 | check     | 356         | >118            | 0               | 0              | 30 | 2  |     | 11 |    | 26  |
| 01/07/98 | check     | no record   | >116            | 0               | 2              | 10 | 6  | 33  |    | 10 | 5   |
| 01/08/98 | check     | 295         | >116            | 0               | 6              | 4  |    | 29  | 2  | 6  | 1   |
| 01/09/98 | pull      | 278         | >116            | 0               | 2              |    |    | 18  | 1  | 6  | 5   |
| 01/20/98 | set       |             |                 |                 |                |    |    |     |    |    |     |
| 01/21/98 | check     | 720         | >114            | 0               | 3              | 8  | 2  | 101 | 2  | 2  | 4   |
| 01/22/98 | check     | 593         | >116            | 0               | 11             | 12 |    | 102 | 2  | 4  | 9   |
| 01/23/98 | check     | 521         | >116            | 0               | 15             | 8  |    | 183 | 2  | 4  | 6   |
| 01/24/98 | check     | 779         | >116            | 0               | 17             | 3  | 8  | 52  | 1  | 8  | 2   |
| 01/25/98 | check     | 715         | >116            | 0               | 6              | 4  | 1  | 52  | 3  | 12 | 3   |
| 01/26/98 | check     | 1081        | >116            | 0               | 20             | 4  |    | 26  | 1  | 16 | 3   |
| 01/27/98 | check     | 1362        | 101             | 0               | 7              | 6  | 1  | 31  | 5  | 3  | 9   |
| 01/28/98 | check     | 1071        | >116            | 0               | 35             | 4  | 3  | 113 | 1  |    |     |
| 01/29/98 | check     | 1690        | 78              | 0               | 36             | 8  | 4  | 68  | 3  |    | 2   |
| 01/30/98 | check     | 1221        | >116            | 0               | 62             |    | 5  | 91  | 1  | 3  | 7   |
| 01/31/98 | pull      | 1044        | >116            | 0               | 8              | 3  | 1  | 4   | 1  |    | 1   |

The candidacy period ends in June 1998, at which time the Department of Fish and Game must make a recommendation to the Commission regarding the listing of spring-run chinook salmon and the Commission will decide whether the listing is warranted. In response to this one-year candidacy period, a Spring-Run Chinook Salmon Protection Plan (Spring-run Plan) was established by the Department and CALFED agencies. (The CALFED Bay-Delta Program is a unique cooperative effort by 15 state and federal agencies with regulatory and management responsibilities in the San Francisco Bay-Sacramento-San Joaquin River Bay-Delta ecosystem to develop a long-term plan to restore ecosystem health and improve water management for beneficial uses of the Bay-Delta ecosystem.) This Spring-run Plan established monitoring of both salmon and environmental parameters (flow, turbidity), and set operational responses if salmon detection indicated spring run may be entering the Delta. The Spring-Plan depended on identifying the time when juvenile spring run are likely entering the delta and taking action to avoid or minimize the effects of SWP and CVP facilities operations on juvenile salmon survival through the Delta. Fish sampling in Mill and Deer creeks is designed to provide data in evaluating the distribution and movement of spring-run salmon through the river and estuary.

#### Recommendations

Tagging techniques to mark juvenile spring run rearing in these tributaries needs to be developed and implemented for identification of spring-run salmon in the Delta. Spring-run salmon yearling emigration should continue to be monitored on a real-time basis. Knowledge of adult and juvenile emigration timing is used in coordinating instream flow with irrigation needs in Mill and Deer creeks and in setting Sacramento-San Joaquin flow standards and water project facilities operational criteria to protect outmigrating spring run.